

## WOMEN AND SOLID WASTE SEGREGATION IN BAUCHI NIGERIA

Bogoro Audu Gani, Ali Chiroma And Bukar Abba Gana  
Urban and Regional Planning Programme  
Abubakar Tafawa Balewa University, Bauchi, Nigeria.  
E-mail: [auduganibogoro@yahoo.com](mailto:auduganibogoro@yahoo.com)

### Abstract

This research is motivated by the lack of adequate solid waste management system in Bauchi metropolis. The research is carried out to identify the role of women with a view to integrating them into household solid waste management in order to achieve a healthy and clean living environment in Bauchi metropolis. Systematic random sampling technique was adopted for the selection of the samples and 4% of the study population was taken as the sample size. The major instruments used for data collection were questionnaire, interview and direct measurement of household solid waste at source and the data is presented in tables and charts. It is found that over 95% of sweeping, cooking and food preparation are exclusively reserved for women in the study area. The women dominate generation, storage and collection of household solid waste with 81%, 96% and 91% respectively within the study area and yet they not integrated in the management. It was revealed that education, income and quantity of waste generation correlate positively and segregation can be 95% effectively carried out by women that have free time. It is recommended that segregation of household solid waste at source in the high density area should be adopted and women should be the key actors in the segregation, and there should be a law to enforce the mandatory segregation of solid wastes at source for all the households in the walled-city. This will not only improve the environmental quality but would also increase the income base of the family.

Key words: Solid waste, Household, Women, Segregation

### 1. INTRODUCTION

Solid waste management practice in Nigeria has largely been focused on the technical issues of waste disposal with little or no attention paid to the social and economic aspects. The new demands for equitable rendering of community services require some paradigm shift in the approach of the service providers. Solid waste management is crucial for providing effective and acceptable health care service delivery.

American solid waste Act (1963) defines solid waste as garbage, refuse and other discarded materials including all materials resulting from all kind of land uses. The United States Environmental Protection Agency described solid waste as any unwanted or discarded material with insufficient liquid content to be free flowing, American Public Works Association (1975). Similarly solid waste is defined as any unwanted and discarded material that is not liquid or gas (Miller, 1994). Olawande (1991) defined solid waste as being a collective name for all the component part of solid waste which may be found in human environment. The definitions given above attempted to give a clear understanding of what constitutes solid waste in their own view. Generally, solid waste can be defined as those material that results from man's activities and are not in the form of liquid or gas but are compacted and substantial which are thrown away for the fact that they are no longer in use, these materials are both in organic and inorganic form they differ in shapes, sizes, forms and compositions, Mantel (1975). However, the factor of time and place which is influenced by technology reduces the acceptability of absolute definition of solid waste.

The process of solid waste management consist of the generation, storage, collection, transportation and final disposal stages in such a way to bring about good environmental sanitation. Sanitation on one hand is the science and practice of affecting a healthy and hygienic condition or the arrangement by which the health of a community is protected from dangers cause by dirt or refuse in the surrounding area. (Adedibu, 1999). On the other hand, solid waste management involves the interplay of many factors in generation, storage, collection and disposal of waste. But management starts with collection, transportation, treatment and disposal.

Time and again, Ogunboye (2003) and Doan (1995) have observed that the failure to take cognizance of the crucial role of women in the management of modern society results in a serious loss of efficiency and productivity, Willson, (2007). A wide range of development programs and projects that involved women were successfully implemented in recent decades. And many studies have been made on women situations and position in the control of urban environment. However urban managers in the developing countries are yet to accept women as active actors instead of victims and passive objects on which various approaches to women and development are being applied. It is time to realize that if projects are to improve women environment, it is essential to identify and to integrate the roles of women in the urban environmental management, especially in the aspect of sustaining environmental quality, in terms of waste management. Moser, (2008). The fact that men and women often play different roles in the society, suggests that we should start to recognize the need and importance of disaggregating environmental issues on the basis of gender. In Africa, including Nigerian, women have been in the frontline of most household socio-economic activities. Throughout the history of human civilization, the roles of women are particularly pronounced in domestic activities. Existing literatures on women and environment in African scene show that women actively participate more than men in solid waste generating

activities in domestic environment. Moser, (1988), enumerated four women's activities that are related to solid waste generation. Firstly, women are identified as managers of traditional environment, in other words, in the areas where they are working to maintain the environment as it already exists. Secondly, women as rehabilitators of the domestic environment –repairing and taking preventive action to underpin sustainable development which is both rural and urban phenomenon, thirdly, as innovators in the use of new more appropriate technology in the creation of clean and healthy domestic environments and finally as protectors and caretakers of domestic environment. The process of solid waste management consist of the storage, collection, transportation and final disposal stages in such a way to bring about good environmental sanitation. Sanitation on the other hand is the science and practice of effecting a healthy and hygienic condition of living environment or the arrangement by which the health of a community is protected from dangers caused by dirt or refuse in the surrounding, Adedibu (1999). Solid waste management involves the interplay between generation, storage, collection, and disposal of waste which cannot be achieved without integrating the women folk. The lack of adequate waste collection and disposal systems in developing countries causes public health problems resulting in diseases, which aggravates poverty and leads to negative consequences such as loss of income due to illness, increased spending on health care, and the deprivation of the poor's capability to live in a safer environment, World Bank, (2001).

The issue of poor environmental sanitation through inadequate solid waste management has become a common feature of many Nigerian cities. Estimates show that 30-50% of solid waste generated in Nigerian cities, are uncollected and disposed of, Falade, (1999). That is why Mabogunje, (2001), concluded that "Nigerian cities are reputed to be some of the dirtiest cities in the world". This gloomy picture of our cities should concern environmentalists because it seems to be pointing accusing fingers at our failures to deliver functionally aesthetic and liveable cities.

Waste management in Bauchi metropolis is performed in three stages by different agencies. Bauchi state protection agency (BASEPA) manages the waste at the metropolitan level while community based organisations non-governmental organisations, trade unions in collaboration with BASEPA take care of the waste at community level. The household members mainly women are in charge of the waste management at the lowest level which is the household level. However the management at the metropolitan and the community levels have not been efficient, as more and more new heaps of solid waste emerged on the surface of residential areas in addition to the old ones that have refused to disappear. Recently farmers have began to reject the municipal solid waste , which was highly patronised as organic manure, but now complaining that it contains high proportion of indecomposable materials e.g. leather and plastics and injurious objects e.g. broken bottles, sharp objects. Secondly the prevalence of scavengers despite its health hazard, public harassment and low social status. The poor solid waste management at these levels originated from the house hold, the sources of the waste as reported by Chwuang , (2007) in his work, 'an appraisal of refuse management in the Makama housing upgrading project, Bauchi town'. He identified the neglect of household (women folk), especially their traditional roles at the household level, as a major factor responsible for poor solid waste management in the area. No direct partnership exists between BASEPA and the household members that produces and can easily segregate the solid waste. If BASEPA will partner with household for appropriate strategies, the problem of solid waste management would be solved in Bauchi metropolis.

It is the aim of this research is to establish the contribution of women in the management of household solid waste with a view to integrate them into the conventional process of solid waste management Bauchi metropolis in order to achieve a healthy and clean living environment in Bauchi metropolitan area.

In Nigeria, the federal ministry of environment has recently reaffirmed its commitment towards municipal solid waste management by establishing six solid waste processing plants for recycling plastics and scrap metals to promote waste management in the country. Fortunately, Bauchi metropolis is picked as the center for the north-east zone. The project aims at collating all the plastics within the benefiting states to turn them in to pellet that can serve as raw materials for households items buckets and slippers. In line with the federal government programme, Bauchi state government, on its own part, has recently purchased two machines for leather recycling with aim of creating employment for the teeming youth; this will in turn improve the environmental quality.

The emergence of new heaps of solid waste in our residential areas in addition to the notorious old ones that have refused to disappear is a call for new and radical sustainable strategies for solid waste management. Zurbrugg, (2003), reported that about 50% of solid waste generated in developing countries is not collected for onward disposal, this has continued to block the drainages which led to flooding, and creating breeding space for insects that spread different kinds of diseases, heaps dumped on the road obstructs smooth flow of both human and vehicular traffic.

Secondly, the daily routine of women activities in many Africa traditional communities involves cooking, household sanitation, processing harvested agricultural produce and small scale home-based industrial production. These activities constitute to a large extent the chief source of solid waste generation in residential neighbourhood in Nigerian cities. However, it is sad to notice that these (producers of solid waste) have no official recognition or role to play within the conventional solid waste management strategies. More so the relationship between family health and environmental sanitation makes women participation in solid waste handling, the better clean the environment and the healthier the family.

Globally, the continues need for studies on urban environmental problems, especially urban solid waste management cannot be over emphasized because despite many workshops, symposia, seminars, and researches on solid waste, still more and more new heaps of solid waste emerged on the surface of residential areas of Bauchi metropolis. It is hoped that result of this research would proffer a sustainable and efficient solid waste management strategy for Bauchi metropolis and other cities with similar residential and demographic characteristic. This research would also provide technical information on solid waste management and open up areas for inquiry which attract other researchers for onward study. To further justify the conduct of this study, it will provide sources of poverty reduction and ways of generating income for the family through waste recycling.

## 2.1 The Role of Women

Women in this context are not a matter of grammatical term, but as an analytical tool to help distinguish between a biological dimension (Sex) and a cultural one (Gender). A person is not born woman or man, but becomes through the influence of society (Mamoud, 2003),

Recognition of the role women can play in transforming society and building capacity must be recognized in regards to integrated pollution and waste management. Usually, women first notice deterioration of environmental conditions, as they are usually associated with responsibility for cleanliness of the home and for the health of the family. They observe a direct impact of the unsanitary conditions such as infectious diseases and childhood diseases, accumulating waste, and lack of sanitation. Since they are responsible for the maintenance of the living space and the health of children, they have a strong sense of civic responsibility and a desire to improve their living conditions and health situation. This is why women seek collective solutions for improving the environment. They are found at the root of many initiatives on health care, waste collection, supply of drinking water, and environmental awareness programs, Bulle (1999). The division between the household and community waste stream is defined by the point at which discarded objects pass from the individual property of the household to the community's waste stream. This boundary, also a gender boundary in relation to waste, often defines the limits of women's autonomy and control of waste materials. Urbanization creates systems to manage waste outside of the household, rather than within it, which could involve reusing, burning, burying, composting, feeding to animals, etc. Usually it is the responsibility of women to take the waste to the point at the boundary of the household at which ownership of the waste actually passes from the household to the community or city.

In a number of the African countries underprivileged women are employees of the waste collection services as street sweepers and cart-operators with such physically challenging tasks as handling refuse, covering long distances, and working long hours in addition to the time spent on their domestic tasks. Often they are uneducated individuals facing difficult family circumstances (e.g., divorced mothers with children) so they treat the waste collection employment by a means of surviving and bringing in an income for their family. For example, four women in 10 employed by the municipal waste collection firm "Les Linguères" in Dakar are divorced, Bulle (1999). They are less hesitant than men when it comes to accepting a job which is underpaid and disrespected by society. As they have little education or are often illiterate, women carry out duties that do nothing to improve their status, such as street sweeping. The women are not involved in decisions about the management of the service they provide because they work long hours and, more importantly, they lack proper training.

In Ouagadougou (Burkina Faso), the community based organization at first only employed men, maintaining that garbage collection was a "typical" man's job. It was only when the high turnover of male collectors began to diminish the effectiveness of the collection service that the organization agreed to employ women. It turned out that women were very reliable employees. These women, from situations of extreme poverty, were bent on doing good work, as they saw this as their only job opportunity, given their lack of employment skills (UWEP, 1998). An example of community recycling of domestic waste by women comes from the Set-Setal settlement in Dakar, Senegal, which has a population of 45,000 (UN-HABITAT, 2001). Before the initiative involving women began, the municipal services could only collect 35% of the 263 cubic metres of waste produced per day, while 51% of households had no toilet facilities and 76% had no convenient systems to process used waste-water which was consequently poured onto the streets. Unemployment rate for men was 28.6% and 24.1% for women. The settlement had a prevalence of infectious diseases such as typhoid and malaria. This situation was worsening by lack of proponents for urban poverty reduction and absence of skills training for urban women. There were no working relationships between the key partners before the project involving women was initiated. The objectives of the project were to clean up of the urban environment through simple processes ranging from the treatment of waste at home to final elimination or final treatment; generation of income for women through creation of jobs in waste recycling.

The results of their efforts include:

- A regular collection of the waste, and eradication of anarchic dumps- thus improving the sanitary and health status of the beneficiaries;
- Generation of income from supplementary activities like waste collection, sale of compost, vegetables and recycled plastic objects;
- Covering the recurrent costs with the financial contribution of the member households.

Additional financial sources include a well managed revolving funds scheme, saving banks and credit totally managed by women leading to better co-ordination amongst the different parties and a greater trust in women from the quarters. The projects translated into municipal savings as the latter did not incur any expenses related to waste management;

- Reinforcement of the managerial capacities and strategic approach of the women through training and exchange visits that allow them to manage the initiative at all levels; and
- Alleviation of the family charges through the employment of jobless youth mostly from female headed households.

The initiative received the Grand Prize Award of the President of the Republic of Senegal. Also, the project was appraised by the Association of Elected Women of Burkina Faso (AFEB). The project has since been replicated in other parts of the country and has been featured as a case study during the USAID International Seminar on the Study of Impact on the Environment.

The situation often looks different when women engaged in the municipal waste collection are organized in community based groups and as a such they demand the right to appropriate training and, in many cases, they put pressure on the waste collection managers to grant them involvement in decision-making process. There is emergence of cooperatives in many instances to help women organize themselves more efficiently. Women are partners when it comes to awareness raising and motivating others, thanks to their direct knowledge of the environment, the sanitation issues involved and their ability to settle conflicts in the neighbourhood. The term “community” denotes the distinctive space between household and the public sector where waste management is neither the full responsibility of individual households nor of the municipal waste department. Community denotes neighborhood spaces like streets, public areas and locations for waste facilities such as disposal sites/containers. In the community, citizens are responsible for waste management. No one considers it strange or unfair that women do not get paid for this activity, even when these activities extend beyond the home to community cleaning. Men, on the other hand, tend only to handle waste when they are paid for it, or when it is specific to their activities.

Usually there is a need to investigate which materials are considered suitable for women to recover/reuse and which ones are reserved for men's activities. Women tend not to be permitted access to higher-value materials like metals or paper, but to focus on textiles, plastics and the like. In some societies the materials themselves appear to be gendered. For example, metals are reserved for men, while women work on lower-value glass, plastic and textiles. In general, materials relating to vehicles and machinery appear to be more likely to be recovered by men, Scheinberg *et al.* (1999).

In recent years it has been observed increased ownership of certain waste management sectors by women. In East and West Africa, for example, women are engaged in small scale trading of recycled waste and some women are the recognized head of a junk shop business. Trading of certain components of the waste stream in these countries is socially accepted for women, Muller and Scheinberg (2002). However, women traders do face obstacles, as an example from Ghana, where women have an age-long tradition of small and large scale trading. In the bottles trade women can be find deal with sales for reuse. However, their incomes aren't big and their expansion of operations is limited by several factors. Lack of financial support, lack of appropriate markets and the women lack the managerial skills due to lack of education. Also, the women have little access to technology because they are limited to only recovering of the material that can still be used or to retail and warehousing, Nibi (1998). Yet another factor determining business expansion are the attitudes towards risk and security in business.

Research has shown that small scale traders, and especially women, place a high value on a secure and stable income, Everts (1998). They will not put their present business at risk through expansion, but rather prefer to diversify into small scale different activities. This attitude (or business acumen) has saved an MSE providing a waste removal service in Dar es Salaam from collapse, when they lost their municipal cleaning contract. They had already diversified to the collection, cleaning and sale of recyclables.

In African context, responsibilities are assigned on the basis of gender disparity. This long held view has tied women to domestic activities that generate over 90% of household solid waste in Nigeria, Bogoro and Harir, (2008)

In Nigeria just as in any African traditional society, socio-economic activities are shared on the basis of gender and age structure and women are responsible for domestic cleanliness as in table 1

Women in most societies are responsible for the domestic work, which include many tasks such as childcare, shopping, cooking, cleaning and wellbeing of their husbands (World bank, 1999).

Moser (1988) enumerated four women's activities that are related to solid waste handling: firstly, as managers of traditional environment, secondly, rehabilitators of the domestic environment, thirdly, innovators in the use of new technology in the creation of healthy and clean environment and finally as protectors and carers of the domestic environment

### 3. METHODOLOGY

Bauchi is one of the towns in northern Nigeria within Sudan Savannah vegetation zone. Bauchi Metropolis, the headquarters of Bauchi State, is located between latitudes 9° 00' and 9° 30' North of the Equator and longitudes 10° 25' and 11° 20' East of the Greenwich Meridian. It occupies a total land area of 3, 604.0 hectares. It is generally less uniform and grasses are shorter than what is obtainable further South. The topography of Bauchi metropolis is relatively flat in the centre. There are ranges of disjointed hills on the north-eastern part of the metropolis.



The instruments used in data collection includes; structured Questionnaire, oral Interview, direct measurement of solid waste on site, Observation, Photograph and Discussion

Bauchi metropolis has a total population of 318,038 people as at June 2010, population census NPC, (2006). There are 39,675 households in the metropolis which formed the target population of the research. The study area was divided into twelve wards (Gunduma) which form the sample frame. From each ward a proportionate unit of household was selected for the purpose of administering questionnaire and interview.

The sample size of this research was determined by the target population size. Since there are 39,675 households in the study area, 4% of 39,675 households were taken as the sample size which is 1587 households.

For a heterogeneous environment like Bauchi metropolis, where population density, income level and probably occupation which to a great extent determined solid generation and characteristics, are quite varied, systematic random sampling techniques was adopted for the selection of the samples. These techniques are the most appropriate for a social survey because they are scientific and easy to apply.

#### **4. RESULTS**

Projected from 2006 census, the population of Bauchi metropolis stood at 318 038 in June 2010, using the National growth rate for urban centres, which is 4.5%. The survey revealed that female dominated with 50.6% (160 972) of the total population see table 2

The table 2 indicates that there are more women than men. Bauchi is a Hausa/Fulani community and by their tradition, since it is the responsibility of the woman to sweep, cook, and clean the surrounding while the children carry the stored waste to the collection centres, then the high number of women in the metropolitan area and the tradition could be a potential for segregation of solid waste at the household level.

Based on the research carried out, it is revealed that within the walled-city, over 40% of the respondents have koranic education as their highest qualification while in the low density areas like the GRAs the respondents with secondary education dominates. However, on average koranic education accounts for 25.9% in the whole metropolis which is the highest and the least is university education which is 4.0%. Only 12.3% did not acquire any form of education and that shows that the literate population of the metropolis is very large. The high level of western education indicates that Bauchi metropolis has enlightened women that should easily and readily co-operate in achieving a healthy living environment through good solid waste management.

From the research, it is discovered that those that are full-time housewife (unemployed) constitute over 60% in the walled-city, while outside the walled-city women that are civil servants or are involved in one business or the other dominates. See table 3

The high proportion of unemployed indicates that most women up to 36.4% in metropolis have free time and no income. This free time can be exploited to generate income through solid waste segregation and since civil servants are relatively free during the weekends, they can also partake in the sorting and segregation even for the sake of environmental cleanliness.

Income level plays a vital role in solid waste generation vis-a-vis its evacuation. In Nigeria, civil servants on GL 01- 05 are referred as low income, whose monthly earnings ranges between ₦5000.00 to 15,000.00, 33.7% of the respondents are within this category. Only 5.8% fit into the high-income group with monthly income of ₦45, 000.00 and above. In a situation where one has very low income or no gainful employment at all, he will be ready to spend her time in sorting and segregating solid waste which can generate income for her instead of throwing it.

The household size directly influenced the amount of solid wastes generated as the higher the household size, the greater the amount of solid wastes generation. It could be seen from table 9 below that 50.3% of the households surveyed have 6-10 persons per household, and 15.4% have 11-15 persons per household, based on that The average household size stands at 8 persons per household. This high household size is a typical characteristic of Hausa tradition.

In terms of solid waste handling, large household size though generated more waste, but can also be advantageous where the family members can sort and segregate the waste themselves. The large household size can provide free and cheap labour for solid wastes evacuation to collection centres and it also encourages community effort toward evacuation of refuse from collection centres to disposal sites.

85.4% of the respondents are married and living together with their households, while only 2.0% are not married. Marriage in this part of the country placed some traditional responsibility on the women including environmental care like handling of solid waste at household level. Therefore the high proportion of the married women could be a potential for sorting and segregation of solid waste at the household level.

##### **4.1 Solid Waste Generated In Bauchi Metropolitan Area**

Turaki, (1982) reported that, residential area in Bauchi metropolis; generate an average volume of 0.003 m<sup>3</sup>/person/day for high density areas, 0.005 m<sup>3</sup>/person/day for high Density areas. On the other hand, Maikano, (2000) observed that in Bauchi metropolis; high-density residential areas generated an average volume of 0.007m<sup>3</sup>/person/day, medium-density areas generated 0.006 m<sup>3</sup> person/day while low-density areas 0.009m<sup>3</sup>/person/day. In the two studies, no account of weight of solid wastes generated was considered and the second researcher, Maikano, claimed that residential density was not a strong factor in determining the quantities of solid wastes generation as asserted by the first researcher.

In another development a World Bank sponsored project, World Bank, (1998) adopted weight as the standard measure for determining amount of solid wastes quantities. For instance data for thirty countries compiled by the World Bank showed that per capita wastes generation ranged between 0.6 and 1.5 kg/capita/day for low income countries and 0.8 and 2.0 kg/capita/day for industrialized countries. For Nigeria, the average per capita waste generation stood at 1.02kg/person/day. The maximum figure was 1.2kg/capita/day recorded in Port Harcourt while the lowest figure was 1.2 kg/capita/day recorded in Minna.

Bauchi metropolis is not one of the high waste generators among Nigerian urban centres. This study discovered that the average solid waste generation for low income earners was 0.0033m<sup>3</sup>/capita/day, 0.0040m<sup>3</sup>/capita/day for medium income earners and 0.0046 for high income areas. The overall average stood at 0.004m<sup>3</sup>/capita/day. See table 4

The volume of solid wastes general in Bauchi metropolis is relatively small but ineffective evacuative was the major factor responsible for accumulation of solid wastes I the metropolis.

Quantitatively, the amount of solid waste generated in Bauchi metropolis is 0.16 kg lower than the national average per capita. The average solid waste generated in high density residential areas at 0.79 kg/capita/day; 0.89 kg/capita/day for medium density residential areas and 1.03 kg/capita/day low-density residential areas. The general average per capital solid waste generated was 0.86 kg/capita/day. Table 5

Researchers have revealed that income level of a society determines the type of its solid waste. In general the higher a country's level of industrialization the higher its income level and the larger its proportion of toxic, non-organic and nonbiodegradable.

#### **4.2 Women and waste segregation in Bauchi metropolis**

Traditionally, some activities that generate solid waste at the household level have been gendered, for example, sweeping, cooking and food processing tend to be exclusively reserve for women. This research discovered that in terms of manual processing of grains, 100% is done by women and over 95% of sweeping, cooking and food processing is still the responsibility of women. Men perform more hectic work like weeding, raking, etc., The research discovered that these activities that relate to solid waste at the house level are performed not only once. Apart from food processing, the women carry out other activities more than once as shown in the table 6. Considering the number of times the activities were being performed, it clearly indicates that a typical woman in Bauchi metropolis spent most of her time either producing or handling solid waste. In assessing the average time spent daily by women to carry out their traditional household activities, it was discovered that over two hours is spent daily in cooking and 30minutes in sweeping and food processing daily. In trying to determine the available time for the sorting and segregation of the solid waste, it was found that in the high density and some medium density wards, over 60% of the women have more than one hour free while 63.9% of the low density areas claimed to have less than 30 minutes free time. The amount of free time, especially by women in the walled city, is a great potential to be exploited and utilized for waste segregation at the household level which is their traditional place of stay. In the research it is revealed that a direct and proportional relationship exist between education, income and the quantity of solid waste generation. It is found that as educational level increases, the income level also rises and those with high income generate more solid waste than those with low income

#### **4.3 Waste Segregation in Bauchi**

Every household is supposed to have a container for temporary storage of the solid waste generated in the house. From the survey it was discovered that more than 90% of the households have storage containers. Most of the households in the metropolis have on one container (dust bin) for temporary storage of all the solid waste generated in the house, only 10% has more than one storage container as shown in the figure 1. With only one solid waste storage container it could be impossible for household to segregate the solid waste generated; this could be one of the reasons why most households in Bauchi metropolis do not segregate their solid waste at the household level. Currently the level of solid waste segregation in the study area is poor, especially in the high density area of the walled-city. Some wards like Dawaki and Dan amar have zero level of segregation as shown in the table 7.

The respondents have different reasons for not participating in solid waste segregation. Up to 67.8% claimed that it is because they have only one container, 21.9% claimed they do not have time and the rest do not see the need for segregation or do not have space for storing all the reasons given above, except 'no time', could be harness as potential to introduce solid waste segregation in the study area. The respondents gave an encouraging response regarding their willingness to segregate their solid waste at the household level. As high as 89.5% indicated their willingness to partake in the segregation and only 7.2% are not willing to participate. From the survey carried it was discovered that very few households participate in partial segregation of solid waste at the household level for different reasons as shown in the figure 2. It is clear that the few that segregate their waste could be low income who wants to reuse or sell valuable materials picked from the waste; however few of them see the need for environmental cleanliness as a good reason for waste segregation which should be encouraged. The results of the data analysed above indicated that the women gender are in the forefront when it comes to general handling of household solid waste either because of socio-cultural or economic reasons. Women dominate the generation and storage of household solid waste with 81% and 96% over men. When it comes to carrying waste to collection centers, still it is the women.

#### 4.4 Potentials and Constraints of Integration of Women In to Solid Waste Management

It is time to realize that if projects are to improve women environment, it is essential to identify and to integrate the roles of women in the urban environmental management, especially in the aspect of sustaining environmental quality. The fact that men and women often play different role in the society, suggest that we should start to recognize the need and importance of disaggregating environmental issues on the basis of gender. In Africa, including Nigerian, women have been in the frontline of most household socio-economic activities in most societies. Throughout the history of human civilization, the roles of women are particularly pronounced in domestic activities. Existing literatures on women and environment in African scene show that women actively participate more than men in solid waste generating activities in domestic environment. Major potentials abound that could be exploited in the integration process of women in the household solid waste management.

In this study, it was discovered that the women folk in Bauchi metropolitan area dominate the gender. The women population accounts for up to 50.60% of the total population, this large number can be of great advantage in terms of labour needed for the integration of the household solid waste more so that it is expected to be performed at the household level. Secondly, another potential is the availability of time the women had. Especially in the walled-city, because of the high unemployment rate of the women, it was found over 60% of the women have more than one hour as free time every day, this confirms the assertion earlier made by Bogoro (2001) that over 80% of the women in Bauchi traditional city are full-time housewives. This free time is sufficient for the segregation of household solid waste generated at the household level on daily basis. Thirdly, the Hausa tradition reserves some domestic activities (sweeping, cooking, food processing, etc.) relating to household solid waste handling as women sole responsibilities. In the study carried out, it was discovered that up to 81%, 96% and 91% of solid waste generation, storage and collection respectively, were carried out by women as their traditional responsibility in the house. Finally, the women interviewed in Bauchi metropolis indicated high degree of willingness (89.5%) to segregate their solid wastes in order to improve the environmental quality and increase their income base by selling the sorted materials. However, in the course of the study some constraints that could militate against effective integration were identified. First and foremost is the low education level of the women. It was found in the study that over 60% of the women did not have formal education where environmental health and personal hygienic taught. This can be corrected by creating awareness and enlightenment to the women on the importance of cleanliness. Another problem is the cultural factor that deters women from participating in any programme without the permission of the husband. Unless the husband agrees, the women would not go for any awareness even if she is free.

#### 5. DISCUSSION

Projected from 2006 census, the population of Bauchi metropolis stood at 318 038 in June 2010, using the National growth rate for urban centres, which is 4.5%. The survey revealed that female dominated with 50.6% (160 972) of the total population who are traditionally responsible for cooking, sweeping and general cleaning of the environment. Over 50% of the household heads were found to be employed with the state and local government whose level of payment is relatively low. Teenagers, formed more than 50% of the entire population, this can be exploited for segregation at household level and organising community labour for evacuation of accumulated solid waste and clear filled drains.

The study found that, out of the 12 wards in Bauchi metropolis, 7 wards are fully enlighten, since up to 40% of the respondents have secondary education and above. However despite the high level of education, the household size is still as high as 8 persons per household and the level of income is relatively low. The findings exhibited a contrary situation where an educationally enlighten society is characterized by low income and high household size. Probably, the situation could be attributed to the type of occupation (mostly civil servants) that dominated in the area.

Bauchi metropolis generates 274 metric tonnes of household solid waste daily with an average of 0.86kg per/capita/day. That means those responsible for waste management have a total quantity of 104 476 tonnes of household solid waste to manage every year. Garbage and ash constitute up to 66% of the waste stream in the metropolis. Income of the household has been found to have the most significant effect on the quantity and composition of the waste generated. High income earners generate more of non- biodegradable solid waste than the low income. After identifying the daily household activities that produce solid waste, it is discovered that it's the women folk that perform those activities. For example, 100% of manual processing of grains is done by women, and over 95% of sweeping, cooking, childcare and food preparation are exclusively reserved for women in African tradition as their responsibilities. The women testified that not less than two and half hours is spent in cooking daily, and over an hour on food and grain processing while more than thirty minutes is used for sweeping daily. Occasionally, household activities like washing, mopping and general cleaning of the house and its surroundings take half of the day every week. Probably because of the low level of westerns education, over 60% of the women in the walled-city (Nassarawa, Dan Kade, Dawaki, Dan Amar and Hardo wards), were found to be unemployed in any gainful occupation. That is why they have more than two hours free time after performing their daily routine, while those in the medium and low density areas said they do not have more than 30 minutes free time daily because most of them are either employed in the civil service or in private sector. The research discovered that educational qualification, employment status and amount of free time are significantly related as shown in the figure 7. It was found that most of the educated women were mostly engaged in gainful employment and have no much free time whereas reverse is the case in the walled-city.

In all the wards it was discovered that over 90% of the household have storage facilities, except Yelwa and Fadaman mada that have 72% and 89% respectively. However up 90% of those who have the storage containers, have only one container for all categories of solid waste generated in the house. The segregation practice in the metropolis is very poor, as only 2% that manage to segregate their solid waste at sources. Fortunately, more than 65% of the respondents said it is because they have only one container for the storage but indicated willingness to segregate their solid waste if given more containers. When the probit model for econometric analysis was applied in all the wards to investigate the probability of solid waste segregation at source, the result of the analysis revealed that there is a high probability for wards in the walled-city to participate in the solid waste segregation at source, as 87% indicated positive response. The result was weak in the medium income earners like Yelwa ward, Dan iya ward, Makama ward, and Ibrahim bako ward, while in high income areas there was no significant indication that solid waste can be segregated at sources. The probability that high income earners would participate in solid waste segregation at source was only 0.2, even the 0.2 could be due to community waste management-related variables like ordinances and penalties.

Segregation pyramid refers to the reduction in terms of the efficiency of women participation segregation of solid waste, as the participation moves upward (from the point of generation to point of disposal) their efficiency reduces from 95% at generation point to just 10% at disposal level, as shown in figure... below. It is found that segregation at source is more efficient, cost effective, less hazardous and requires little time than at the disposal level. This is because women can only participate effectively if it is done within the house than outside see fig 8 Chuwang (1997) reported that sex and age are the main determining factors in household refuse handling, particularly carrying the filled storage facilities to collection centres. He further asserted that women and girls gather, store and evacuate the refuse in the household, a responsibility which he attributed to African culture irrespective of income level. In the same vein, this study observed women dominate the handling of solid waste at household level and that low-density areas specially employed the service of hired labourer especially women or/and maids to carry the refuse to collection centres. It implies that with improved income level more labourers would be required for waste collection and hence a clean environment would be achieved. The research found that women dominate generation, storage and collection of household solid with 81%, 96% and 91% respectively within the study area while men were much involve in the disposal. The involvement of men in the disposal is up to 81%.

This study found that potentials abound that could be harness for optimum integration of women in the household solid waste management through segregation at source. It is revealed tthat there are more women (50.65) than men in Bauchi metropolis, especially in the walled-city because of the high unemployment rate of the women, it was found that over 60% of the women have more than one hour as free time every day, again, the Hausa tradition reserves some domestic activities (sweeping, cooking, food processing, etc.) relating to household solid waste handling as women sole responsibilities and 89.5% are willing to segregate their solid waste at source. However, the major constraint could be the low level of their education which may affect their appreciation for personal hygiene and environmental health, through creating awareness this can be corrected. Another problem is the cultural factor that deters women from participating in any programme without the permission of the husband. Unless the husband agrees, the women would not go for any awareness even if she is free.

The research revealed that only Bauchi State Environmental Protection Agency (BASEPA) currently manage solid waste in Bauchi metropolitan area. Though, solid waste management was one of the statutory functions of Bauchi local government assigned to it by the 1979 and 1989 constitution of federal republic of Nigeria. But since it ceased to perform such functions like wise Bauchi state urban development board, solid waste handling was among the activities but with establishment of a task force on environmental sanitation in 1986, the task force took over solid waste collection and enforcement of all sanitation laws, in the state, the task force existed for ten years and was later dissolved during the democratization process, finally, Bauchi State Environmental Protection Agency was established by Edict No. 3 of 1997 and came into force on 10<sup>th</sup> June 1997 to replace and take over the activities of the defunct task force on Environmental Sanitation which was abrogated in 1996. This research found that BASEPA is currently using three techniques for solid waste management that do not involve segregation at any level. These are private-public partnership technique, where some parts of its activities are giving to private organizations, community participation technique, this is where the agency collaborate with CBOs NGOs, youths and tippers association to collect and dispose solid waste and the direct management technique is where the agency (BASEPA) directly carries out solid waste management alone The study discovered that BASEPA uses three techniques for the management of solid waste in the metropolis, these are; the direct management technique, community participation technique and the public-private partnership. It was found that the former though commonly practice and not gender sensitive, but suffers from poor funding and inadequate staffing and equipment. The second is occasional but very effective, while the later is also effective and gender sensitive but financially demanding and not sustainable because of political instability. It was found at the time of this study that BASEPA has major problems that crippled its operations, like inadequate skilled and unskilled manpower, inadequate and poor condition of equipments and machineries, and financial constraints, due to aforementioned problems BASEPA evacuate only 62.4% of the solid waste generated in Bauchi metropolitan area. As heaps of solid waste continues to grow and new illegal dumping sites emerged that block drainages, the government felt the option it has, is to employ the services of private organization like the cosmopolitan cleaners and others to participate in the waste collection in the



metropolis In this study, the strategists used in solid waste management in Bauchi metropolis were appraised with a view to identifying their strength and weaknesses. There has been failure to take cognizance of the crucial and important roles of women in the solid waste management in Bauchi metropolis which results in a serious loss of efficiency and productivity on the side of the management agencies. The roles of women were identified and integrated into the solid waste management strategists through segregation of household solid waste at source which has been neglected. This is with a view to achieving a clean and healthy living environment in Bauchi metropolis.

### 5.1 Conclusion

Bauchi metropolis generates 286 metric tonnes of household solid waste daily with garbage and ash constituting up to 66% of the waste stream. BASEPA, which is the only agency that is responsible for the disposal of solid waste in the metropolis, only evacuates 184 metric tonnes (62.41%) daily, leaving 102 metric tonnes (37.59%) of the household solid waste uncollected. Women who are traditionally responsible for cooking, sweeping and general cleaning of the environment dominated with 50.6% (160 972) of the total population. Despite the high level of education, the household size is still as high as 8 persons per household and the level of income is relatively low. The findings exhibited a contrary situation where an educationally enlighten society is characterized by low income and high household size. Probably, the situation could be attributed to the type of occupation (mostly civil servants) that dominated in the area. 100% of manual processing of grains is done by women, and over 95% of sweeping, cooking and food preparation are exclusively reserved for women, these are waste generating activities. over 60% of the women in the walled-city were found to be unemployed, that is why they have more than two hours free time after performing their daily routine, The probit model for econometric analysis revealed that there is a high probability for wards in the walled-city to participate in the solid waste segregation at source, as 87% indicated positive response, while in high income areas there was no significant indication that solid waste can be segregated at sources. The probability that high income earners would participate in solid waste segregation at source was only 2%. It is found that as educational level increases, the income levels also suppose to rise and those with high income generate more solid waste than those with low income. There is significant relationship between employment status and the amount of free time by women in the study area; women without employment have more free time, also there is significant difference in terms of segregation of solid waste at household level between women that have free time and those that do not have free time, those with free time would actively and readily participate in the segregation at the household level.

### 5.2 Recommendations

Based on the results of the findings by this research, immediate and long-term measures are being recommended for proper integration of women in to household solid waste management in Bauchi metropolis. A strong legislation is also recommended for enforcement of the proposal as shown in figure 9 Now that many collection centres are already overflowing, and many unauthorised dumping sites have emerged, an immediate joint action should be adopted to evacuate the wastes accumulated in order to restore environmental sanity in the metropolis. This can be achieved by establishing a strong joint-action team comprising of staff of BASEPA, heads of the communities, private organization, community based organizations, non-governmental organizations, trade unions and youth organisations. A one-month sanitation exercise should be declared in the metropolis to be observed during work free days. 'Stop' notices should be placed on all unauthorised dumping sites sand a monitoring team comprising staff of the agency and representative of the communities should supervise the collection and disposal of waste. For immediate evacuation, BASEPA should contract the evacuation of outside walled-city to private contractors to be completed within one month, meanwhile the agency would mobilised all its resources (equipment/vehicles and staff) and concentrate on the walled city. Bauchi local government should source fund from National Ecological Fund to procure refuse handling equipment in order to resume its statutory function of solid waste collection. The local government should limit its service within the walled city where heaps of solid waste are indiscriminately scattered around, this will compliment the work BASEPA within the walled-city. However the agency would constantly offer technical assistant and professional advice to the local government when the need arise. Segregation of household solid waste at source is a panacea for effective management of solid waste. Segregating wastes at the source of generation can be more cost-effective at residential land use than in other land uses because the participation of a solid waste generators can be augmented by free time and tradition responsibilities. Since from the survey it was revealed that only the walled-city has high probability for participating in the solid waste segregation at source; because as high as 87% indicated positive response. The result was weak in the medium income earners like Yelwa ward, Dan iya ward, Makama ward, and Ibrahim bako ward, while in the high income areas there was no significant indication that solid waste can be segregated at sources.

It is therefore recommended that segregation at source should be practiced only in the walled-city. The exercise should be carried out in three stages as follows: The first stage should be the separation of toxic waste from non-toxic waste. The toxic waste like batteries, chemicals, paints and others should be carefully be separated from other wastes and stored in a covered storage facility and kept out of reach of children. At the second stage, the non-toxic waste which contain recyclable and non-recycable materials should also be sorted into two groups. The non-recyclable materials which comprises of ash, garbage, food scrubs and other biodegradable materials should be taken to communal collection centers for onward evacuation to disposal site. The final stage should be the separation of the recyclable materials into

metallic and aluminium materials in one container and polythene and plastics on the other container. Three temporary storage containers of different sizes and colours that can contain all the solid waste that can be generated in a week, at household level; one with cover for toxic waste, one for metals and aluminiums and the other for plastics and polythene should be kept at the household level as in figure 10. The provision of the new law that requires households to divert at least 50% of solid wastes generated within the next five years. The law should require the community heads to undertake very aggressive resource recovery and recycling programs in their respective communities. The law should, however, provide for mechanisms to help the communities this waste diversion target, one of which is the mandatory waste segregation at source. This provision is intended to directly support and promote waste management practices that reduce the volume of wastes brought to final disposal sites. Some of these practices include waste minimization, reusing, recycling and composting. The survey results of the present study indicate that mandating households to segregate their wastes through local ordinances are important to promote compliance. In addition, it is necessary that the community residents are made aware of the benefits of waste segregation for them to engage in a waste management program. It is important too, that the problems in implementing waste segregation and resource recovery are considered when designing other community programs.

There is room for promoting increased resource recovery at the household level, particularly in the area of composting of biodegradable wastes and recovery of recyclable materials, such as aluminum cans, paper-based wastes (other than old newspapers) and plastic wastes. A good baseline information on waste management-related concerns should be made available for effective waste management and decision-making at the all levels. The following information – quantity and composition of wastes generated, collected and disposed; quantity of wastes diverted by households, waste collectors and other agents; amount of wastes illegally dumped; amount and types of materials re-processed in recycling plants. In designing their solid waste management programs, government must be aware that waste management is an activity that requires time and effort on the part of the household. The SWM program therefore, must emphasize the benefits to the community as well as to the household, of the adoption of improved solid waste management practices. It would be useful for households that embark on waste segregation and resource recovery programs, to estimate the potential economic savings they can derive from their activities, and use this information to solicit the assistance of the government. They must stress to the residents that any financial resources saved would mean available resources for non-SWM basic services such as health and education. At the household level, the SWM program should demonstrate the benefits of waste segregation and composting in terms of cleaner household premises that promote better health conditions of household members.

There should be an ecological legislation on Solid Waste Management to be enacted largely in response to the growing and emerging heaps of solid waste on the urban land and scarcity of disposal sites, particularly in the traditional city. The law should emphasize on solid waste avoidance and volume reduction through source reduction and waste minimization measures, with the protection of public health and the environment as the primary goal. The following provisions of the law that are of interest to the present study are listed below.

- a) The law should establish a mandatory, solid waste diversion rate of 45% within the next three years at the household level. This will require each ward within the walled-city in the next three years to divert annually, on the average, 15% of its solid wastes away from waste disposal facilities into resource recovery activities such as reusing, recycling and composting.
- b) The law should enforce the mandatory segregation of solid wastes at source to include all the households in the walled-city.  
The wastes will be segregated and properly marked as can-be-composted, non-recyclable, recyclable or special wastes. Segregation and collection of biodegradable, can-be-composted and reusable wastes shall be conducted at the ward level, while collection of non-recyclable materials and special wastes shall be the responsibility of Bauchi Local Government and Bauchi State Environmental Protection Agency.
- c) The law should provide for establishing recycling and composting programs, including an inventory of existing markets for recyclable and can-be-composted materials, the establishment of materials recovery facilities at the local level and setting up of drop-off locations for recyclable materials. Standards for non-environmentally acceptable products and packaging will be developed and imposed on all household solid waste.
- d) The already existing law on monthly sanitation, which is observed on every last Saturday of the month, should be maintained right at the household level to the entire metropolitan area.

The residents are required to bring their segregated garbage to specified drop-off points that are situated in most of the street corners. Each drop zone should have a covered drum for can-be-composted wastes, trash hangers with four plastic sacks for recyclable papers, cartons, bottles and steel, and a garbage cage made of plastic net, steel and round bars to store disposable wastes to prevent animals from scattering the trash. The can-be-composted wastes are collected

from 6am to 8am daily, while the recyclables are brought to the redemption center for storage until there is sufficient for sale.

Although economic incentives and educational programs are imperative in cultivating sustainable waste management practices, the role of enforcement is also crucial. Especially at the outset of a SWM program that seeks to alter public behavior, penalties have to be associated with failure to comply. If the desired course of action (i.e. segregation-at-source) has to compete with the option to dispose of waste for free at anytime and anywhere without reprisal, success of the program will be extremely difficult. It is probable that many people will not change their waste disposal habits if the way of disposing of waste familiar to them is available as a free option. All perceived options should be associated with relevant benefits and costs. Incentives and penalties are two themes that are integrated throughout this report; however, neither will be very effective if the law regarding proper disposal methods is not taken seriously. Current behavior will likely not change unless people are taught that it is wrong (education), encouraged to do the right thing (incentives), given the means to do the right thing (convenient, effective infrastructure and services), and shown the consequences for not doing the right thing (enforcement). This section suggests some methods of enhancing the enforcement of solid waste management to help cultivate a culture of waste management. Finally, we wish to state that in our opinion, enforcement should be coordinated between the different levels of government and community groups. The collective responsibility between different sectors of society could build more trust and compliance than if it were top-down enforcement only. Networking between groups charged with enforcement (especially between different wards) will be fundamental to stopping illegal dumping. To be successful, enforcement needs to be well-coordinated and well-financed. Especially at the outset, the Solid Waste Management system will have to relay the idea that there are specific penalties assigned for the non-compliance of waste disposal ordinances.

To this end, it would be useful to find creative ways to involve all members of the community in helping invoke change in people's waste disposal behavior. Along with strict penalties, the wards involved a group of community volunteers that helped make sure people followed the new rules as set out by the local council. This will be a group of community members who will believe in the value of a clean neighborhood and are willing to donate their time toward this end. A similar volunteer group could be formed at the municipal level in Bauchi. Their role in the community could range from watch dogs reporting on improper disposal activities, to educators helping raise awareness of the benefits of a clean environment.

This project has highlighted important aspects that need to be taken into consideration in the design and delivery of domestic solid waste services. The ideas raised emphasised the fact that solid waste services should be managed in context. This requires a paradigm shift from the traditional approaches that are technological biased and often prejudice to the socio-economic aspects of the community. The need to shape the operation of domestic waste services to accommodate the socio-cultural and economic realities in the communities is inevitable. The concrete facts are that:

- Solid waste management services forms the core of municipal services and cannot be sustained without community cooperation and participation in all operations. The designed system should be user friendly and sustainable. To this end, efforts are needed to assess the profiles of each community as each one is unique and so are the needs, aspirations and challenges. The understanding of the demographic characteristics of communities within the local authorities' operational area is vital for the delivery of accessible, affordable, relevant, acceptable and effective services.
- Gender relations are equally important. Women form the larger proportion of society worldwide and constitute the most vulnerable population groups to inappropriate service system designs in particular, solid waste collection systems. One of the shortcomings of the current solid waste collection systems is their male bias regardless of the fact that women constitute the majority of the service recipients.

## REFERENCE

- Adedibu, A.A., (1999) 'A Comparative Analysis of Solid Waste Generation And Composition In Ilorin And Offa, Kwara State. Paper Presented At The National Conference On Development And Environment Organised By N I S E R University Of Ibadan From 22<sup>nd</sup> – 25<sup>th</sup> March 1999.
- African Development Bank (2002), Study Report On Solid Waste Management: Sustainable Options For Africa
- Agunwamba, J. C., (1998). Analysis of scavengers' activities and recycling in some cities of Nigeria. *Environmental Management*, **32** (1): 116-127.
- American Public Works Association (2005) Solid Waste Collection Practices. Illinois Publication Chicago
- Ayres, R.U. and L.W. Ayres. (1996). *Industrial Ecology: Towards Closing the Materials Cycle*. Edward Elgar, Cheltenham, UK.
- Barnard G & Kristoferson L. (1985) Agricultural Residues as Fuel in the Third World. London, Earthscan,
- Bogoro A.G. (2001) Evacuation Of Solid Waste In Residential Area Of Bauchi Metropolis. M.Sc Thesis University Of Jos

- Bulle S., (1999). Issues And Results Of Community Participation In Urban Environment. UWEP Working Document 11. ENDA/WASTE, Gonda, The Netherlands, March.
- Chuwang B. Z., (1997) An Appraisal Of Residential Refuse Management In The Makama Housing Upgrading Project, Bauchi Town. An Unpublished M.Sc., Thesis, Department Of Geography And Planning, University Of Jos.
- Cointreau, S. J., (1982). Environmental management of urban solid waste in developing countries: a project guide. Urban Development Technical paper No 5. The World Bank, Washington, DC. June .
- Dauda, M., And Osita, O.O.,(2003). Solid waste management and reuse in Maiduguri, Nigeria. 29th WEDC International Conference towards the Millennium Development Goal, Abuja.
- Deji R.A. (1990). The Environment And Its Resources. Gordon And Breach Science Publishers, Pans.
- Dias, S. (2010) Belo Horizonte Selective Waste Collection Programme. WIEGO Publications, Cambridge
- Diaz, L., (1999). An Overview Of Solid Waste Management In Economically Developing Countries. A Regional Conference On Integrated Solid Waste Management. Cape Town, South Africa, October 25.
- Doan P. (1995). Institutionalizing Household Waste Collection.. HABITAT International Vol. 22 No.2 Pg98 – 113.
- Dong Q. Z., Soon K. T. And Richard M. G. (2010) Municipal Solid Waste Management In China: Problem And Challenges In ELSIVIER Journal Of Environmental Management
- Eugenia C.B. (2002) Solid Waste Segregation And Recycling In Metro Manila: Household Attitudes And Behaviour. Illinois Pulication Chicago
- Everts, S. I., (1998). Technology Transfer For Women Entrepreneurs: Issues For Consideration. Gender, Technology And Development, Vol.2 (1).
- Falade J. B. (2001) Amenity And Open Spaces Contents Of Nigerian Planning Legislation. A Paper Presented At The Policy Seminar On Environmental Issues And Management In Nigerian Development Held At The Department Of Geography University Of Benin. 4<sup>th</sup> – 7<sup>th</sup> April 2001
- Fatimah N. (1982) "The Role of Women in the Scavenging System at Jati Dua, Bandung." Centre for Environmental Studies, Institut Teknologi Bandung, unpublished,
- Furedy C. "Appropriate Technology for Urban Wastes in Asia." *BioCycle*, July, 1989, pp. 56-59.
- Georgescu-Roegen. (1971). The Entropy Law and the Economic Process. Harvard University Press. Cambridge, Mass.
- Ghosh, A., (2001). Environmental Improvement Through Solid Waste And Public Health. A Study On Post-Plague Initiatives Of Surat Municipal Corporation. Institute For Social Services, New Delhi, India.
- Giovanni A. (1987) Cornia notes the conserving aspect of "survival strategies" in the chapter "Adjustment at the household level: potentials and limitations of survival strategies," pp. 90-104, in *Adjustment with a Human Face*, edited by G. A. Cornia, R. Jolly, and F. Stewart. Oxford, Clarendon Press,
- Henstock M.E. (1975). Solid Waste As Resources. Pergamon Press. New York
- Holloway, A., (1995). Challenges For Long-Term Disaster Reduction: Elements Of Telemedicine, Harare, Zimbabwe, Unpublished (After UNEP, GEO-2000, [www.unep.org](http://www.unep.org)).
- James, D.E. (1980). A System of Energy Accounts for Australia. Economic Record. June, 1980.
- James, D. (1985). Environmental Economics, Industrial Process Models and Regional Residuals Management Models. In A.V. Kneese and J.M. Sweeney. Editors. Handbook of Environmental and Resource Economics. North-Holland, Amsterdam.
- Kamel, L.I., (1994). Mokattam Garbage Village, Cairo, Egypt. Stallion Graphics, Cairo, Egypt.
- Keziah K.L. (2009), A Study Of Residential Solid Waste Management In Bauchi Traditional Area. Unpublished Project, Abubakar Tafawa Balewa University, Bauchi
- Kinnaman, T.C. And D. Fullerton. (2000). The Economics Of Residential Solid Waste Management. In Tietenberg, T. And H. Folmer. 2000. The International Yearbook Of Environmental And Resource Economics 2000/2001: A Survey Of Current Issues. Edward Elgar.
- Kneese, A.V.; R.U. Ayres and R.C. D'Arge .(1970). Economics and the Environment: A Materials Balance Approach. Resources for the Future. Washington, D.C.
- Lave, L.B.; C.H. Hendrickson; N.M. Conway-Schempff; And F.C. Mcmichael. (1999). Municipal Solid Waste Recycling Issues. Prepared Under U.S. EPA Cooperative Agreement No. CR825188-01-2.
- Leontief, W. (1986). Input-Output Economics. Second Edition. Oxford University Press, New York.
- Liptak B. G. (1991). Municipal Waste Disposal In The 1990s. Chilton Book Company Pennsylvania
- Listori, J. A., (1995). Environmental Health In Africa - A Detailed Look At Sub-Saharan Lnfrastructure Projects, 1984 - 1994. Washington DC: World Bank.
- Lvovsky, K., (2000). Health And Environment. Environmental Strategy Background Paper. Washington, DC. The World Bank, April (Draft For Discussion).
- Mabogunje, A.L. (2001), Lessons Of Experience In Housing Low-Income Groups In Sub-Saharan Africa, Paper Presented At International Conference On Housing Andurban Development For Low Income Groups In Sub-Saharan Africa, Held In Accra, Ghana, 22-26 July 2002.



- Maikano A. H., (2001) Residential Solid Waste Generation In Bauchi. Unpublished B.Tech. U R P Thesis, Abubakar Tafawa Balewa University, Bauchi.
- Mantell C. A. (1975). Solid Waste Origin Collection Processing And Disposal. John Willey And Sons Inc. London.
- Medina, M. (2005) Waste Picker Cooperatives in Developing Countries. Paper prepared for WIEGO/Cornell/SEWA Conference on Membership-Based Organizations of the Poor, Ahmedabad, India, January 2005
- Miller G. T.(1990), *Living In The Environment: An Introduction To Environmental Science*. Wadsworth Publishing Company, Belmont, California
- Murray, C. J., And A. D. Lopez, (1996). The Global Burden Of Disease. Cambridge, Mass.: Harvard University Press.
- Nibi, S.J., (1998). Gender And Waste. WASTE, UWEP Working Document No. 12.
- Ogunboye A.A. (2003). Institutional Framework For Managing Metropolitan Solid Waste. International Journal Of Environmental Issues. Vol. I No2 Dec. 2003, Pg152 – 163.
- Ogwueleka, T.C., (2003). Analysis of urban solid waste in Nsukka, Nigeria. Journal of Solid Waste Technology and Management, **29** (4): 239-246.
- Oluwande P. (1991). Assessment Of Metropolitan Waste Management Problem In China And Africa, In Managing Solid Waste In Developing Countries Ed. J.D. Holmes. John Willey And Sons New York.
- Russell, C.S. (1973). Residuals Management in Industry: A Case Study of Petroleum Refining. Resources for the Future. Washington, D.C.
- Russell, C.S. and W.J. Vaughan. (1976). Steel Production: Processes, Products and Residuals. Resources for the Future. Washington, D.C.
- Samson, Melanie. (2009) Refusing to be Cast Aside: Waste Pickers Organising Around the World. WIEGO publications, Cambridge
- Scheinberg A, Muller M. and Tasheva El, (1999) Gender And Waste. Integrating Gender Into Community Waste Management: Project Management Insights And Tips From An E-Mail Conference, 9-13 May, 1998. Sept., 1999
- Tavengwa, T., (1995). SADC Unites In War Against Malaria: WHO Lays Platform Of Action. The Herald, December 7. Harare, Zimbabwe
- USEPA (U.S. Environmental Protection Agency). Characterization Of Municipal Solid Waste In The United States: (1998) Update. EPA530-R-99-021.September
- UWEP, (1998). Study Of Waste Handling, Ouagadougou, Burkina Faso. WASTE, Gouda, The Netherlands.
- WB (World Bank). (1998). Solid Waste Ecological Enhancement Project (SWEEP).Sector Assessment Report. Manila, Philippine
- Wentz C. A. (1989). Hazardous Waste Management. Mcgraw Hill Book New-York.
- Wilson D.G., (1977) Handbook Of Solid Wastemanagement. Van Nostrand Reinhold Company, New York.
- Zira V.P. (1998), Public Participation In The Management Of Household Solid Waste In Jos Township, Unpublished M,Sc Thesis, University Of Jos
- Zurbrugg, C., (2009). Urban Solid Waste Management In Low-Income Countries Of Asia, How To Cope With The Garbage Crisis, Available In The Website: [Http://Www.Sandec.Ch](http://Www.Sandec.Ch).

**Table 1 Women Daily Activities in Nigeria**

Sex	Sweeping	Storage	Collection	Evacuation
Male	32.47	24.50	78.70	80.08
Female	67.53	75.50	21.30	19.92
<b>T O T A L</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>

*Source;- Zira, 1998*

**Table 2 Age-sex Distribution of the Population of Bauchi Metropolis**

Age	Male		Female		Total	
	N		No	%	No	%
Less than14	52158	16.4	50886	16.	044	32.4
15-	2896	9.4	31168	9.8	61063	19.2
25-34	25443	8.0	15443	8.0	50886	16.0
35-44	22899	7.2	22581	7.1	45479	14.3
45-	1940	6.1	19082	6.0	38483	12.1
55 and above	7315	2.3	11767	3.7	19082	6.0
<b>Total</b>	157111	49.4	160972	50,6	318038	100.0

**Source:** National Population Commission 2010 Census).

**Table 3 Occupation Of Respondents**

Ward	Civil servant	Farming	Business	Students	Unemployed
Old G R A	76.0	6.3	5.2	2.7	10.1
New G R A	80.4	2.5	3.0	7.3	6.8
F/ Mada	51.7	10.4	13.3	4.3	20.3
Yelwa	20.2	37.4	22.9	11.1	8.4
Dan Iya	60.8	5.3	12.1	5.8	16/0
Makam a	37.8	9.1	21.8	8.5	22.8
I/ Bako	41.0	18.3	20.1	6.3	14.3
Nassaraw a	12.3	3.9	20.5	1.0	62.3
Dan Kade	15.3	2.1	10.1	2.1	70.4
Dawaki	8.4	4.1	8.9	3.9	74.7
Dan Amar	8.3	9.6	7.6	2.7	71.8
Hardo	27.2	1.3	10.4	1.4	59.2
<b>Total</b>	<b>36.6</b>	<b>9.2</b>	<b>13.0</b>	<b>4.8</b>	<b>36.4</b>

**Sources:** Field Survey, June 2010

**Table 4 Pa Capita Solid Waste Generation In Cubic Meter (M<sup>3</sup>)**

Ward	Density	Garbage	Rubbish	Trash	Ash	Polythene	Total (M <sup>3</sup> )	Average (M <sup>3</sup> )
Old G R A	Low	0.0111	0.0057	0.0048	0.0010	0.0053	0.0297	0.0047
New G R A	Low	0.0092	0.0061	0.0052	0.0008	0.0047	0.0260	0.0043
F/Mada	Low	0.0100	0.0067	0.0060	0.0012	0.0060	0.0299	0.0050
Yelwa	Medium	0.0100	0.0060	0.0041	0.0041	0.0040	0.0282	0.0047
Dan Iya	Medium	0.0072	0.0059	0.0052	0.0034	0.0054	0.0271	0.0045
Makama	Medium	0.0052	0.0062	0.0048	0.0037	0.0049	0.0248	0.0041
I/ Bako	Medium	0.0070	0.0049	0.0050	0.0024	0.0046	0.0239	0.0040
Nassarawa	High	0.0039	0.0047	0.0051	0.0043	0.0035	0.0215	0.0036
Dan Kade	High	0.0033	0.0050	0.0045	0.0051	0.0038	0.0217	0.0036
Dawaki	High	0.0041	0.0032	0.0047	0.0038	0.0028	0.0186	0.0031
Dan Amar	High	0.0037	0.0028	0.0037	0.0051	0.0026	0.0179	0.0030
Hardo	High	0.004	0.0037	0.0044	0.0041	0.0038	0.0200	0.0033
<b>Total (M<sup>3</sup>)</b>		<b>0.0787</b>	<b>0.0609</b>	<b>0.0575</b>	<b>0.0390</b>	<b>0.0514</b>	<b>0.2875</b>	
<b>Average (M<sup>3</sup>)</b>		<b>0.0066</b>	<b>0.0051</b>	<b>0.0048</b>	<b>0.0033</b>	<b>0.0049</b>		

**Source:** Field Survey June 2011

**Table 7 Segregation At Household Level Inpercentages**

Ward	Segregation (%)	Resources Recovery (%)	No Segregation %
<b>Old g r a</b>	2	21	77
<b>New g r a</b>	0	13	87
<b>F/ mada</b>	2	30	68
<b>Yelwa</b>	1	40	59
<b>Dan iya</b>	3	36	61
<b>Makama</b>	3	42	55
<b>I/ bako</b>	7	36	57

**Table 19 Reasons for not practicing Waste Segregation**

**Table 5 Pa Capita Solid Waste Generation In kilogramme (Kg)**

Ward	Density	Garbage	Rubbish	Trash	Ash	Polythene	Total (kg)	Avg (kg)
Old G R A	Low	1.12	0.99	1.00	0.45	1.57	5.13	1.03
New G R A	Low	1.28	0.90	1.10	0.30	1.44	5.02	1.00
F/Mada	Low	1.02	1.11	0.80	0.65	1.31	4.89	0.98
Yelwa	Medium	0.86	0.91	1.03	0.77	0.99	4.56	0.91
Dan Iya	Medium	0.76	0.83	0.91	0.64	0.87	4.01	0.80
Makama	Medium	0.62	0.58	0.75	1.08	1.00	4.03	0.81
I/ Bako	Medium	0.80	0.92	0.78	0.87	1.04	4.41	0.88
Nassarawa	High	0.37	0.75	0.50	1.34	0.54	3.50	0.70
Dan Kade	High	0.52	0.67	0.71	1.54	0.80	4.24	0.85
Dawaki	High	0.41	0.82	0.49	1.66	0.61	3.99	0.80
Dan Amar	High	0.52	0.54	0.62	1.47	0.48	3.49	0.70
Hardo	High	0.61	0.47	0.51	1.21	0.69	3.49	0.70
<b>Total (kg)</b>		8.75	9.49	9.20	12.0	11.31	<b>50.74</b>	
<b>Average (kg)</b>		0.73	0.79	0.77	1.00	0.95		

**Source:** Field Survey June 2011

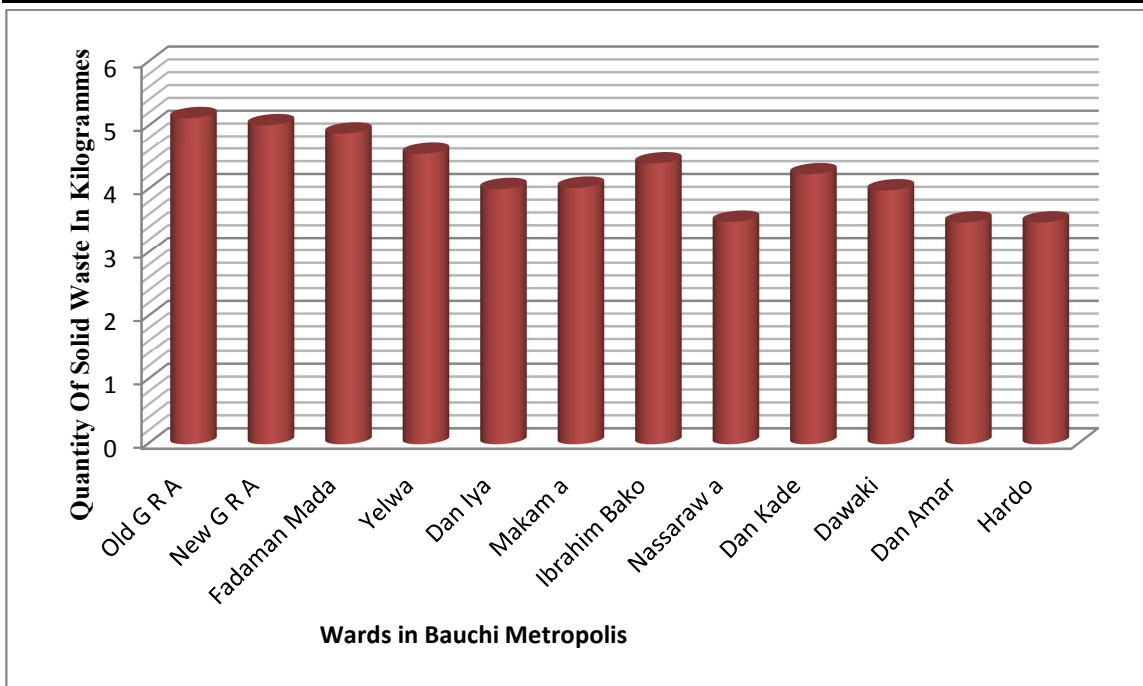
**Table 6 Distribution of Activities**

Activity	Male	Female
<b>Sweeping</b>	2.47	97.53
<b>Cooking</b>	8.51	91.49
<b>Food Processing</b>	1	99
<b>Manual Grain Processing</b>	0	100
<b>Raking</b>	57.91	42.19
<b>Weeding</b>	90.43	9.57
<b>Washing</b>	28.62	71.38

**S  
o  
u  
r  
c  
e  
:**

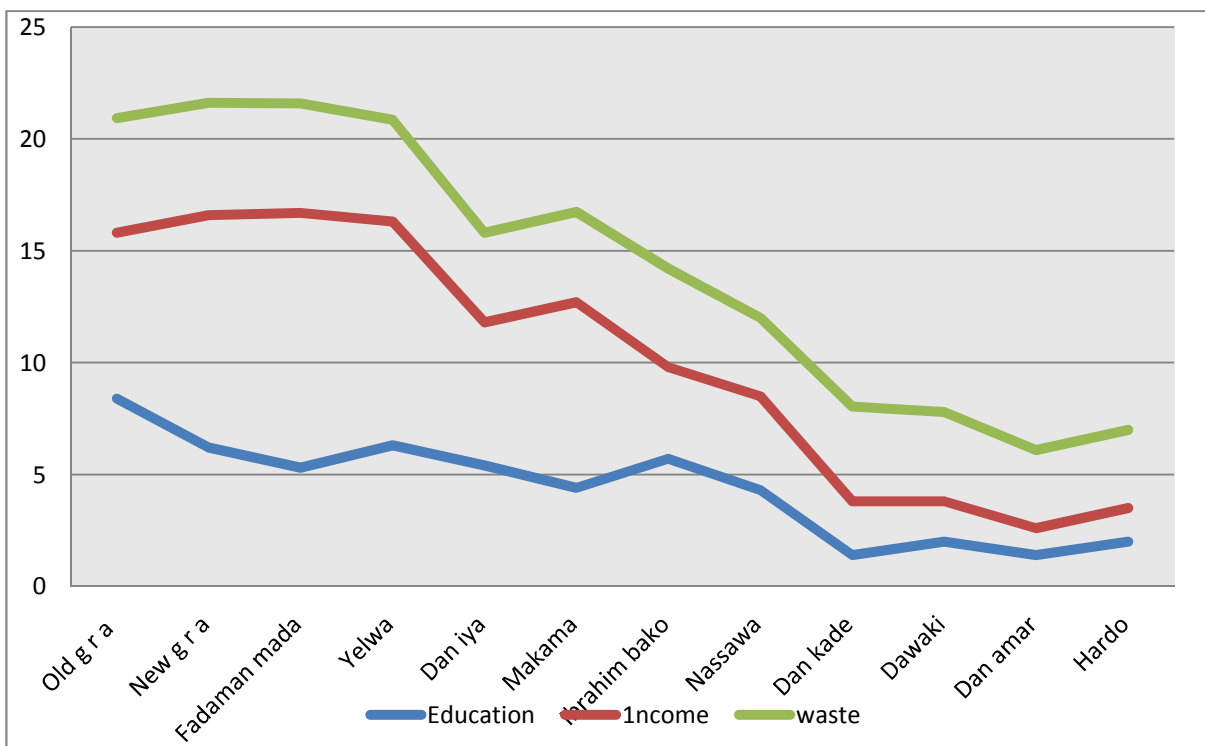
Field Survey, June 2010





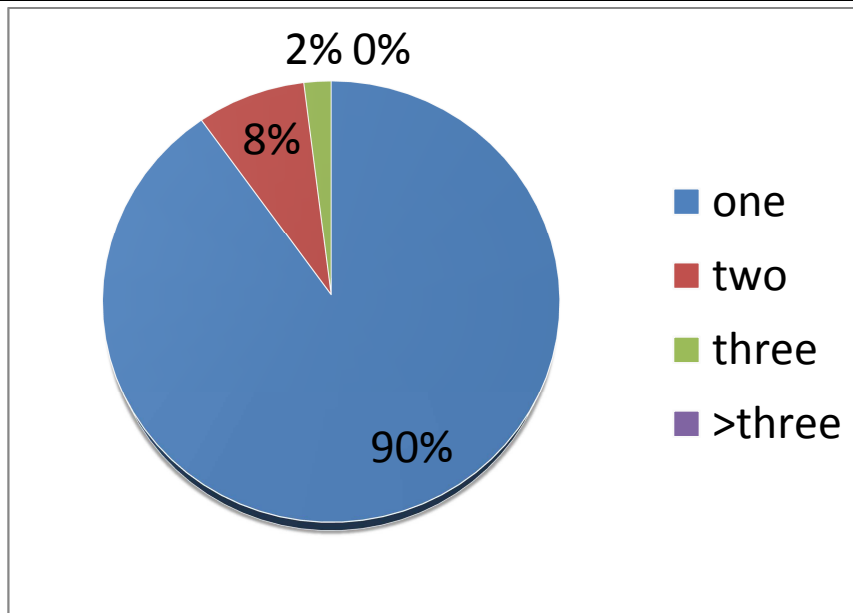
**Source:** Field Survey, June 2010

Figure 1 Quantity of Solid Waste Generation by Wards

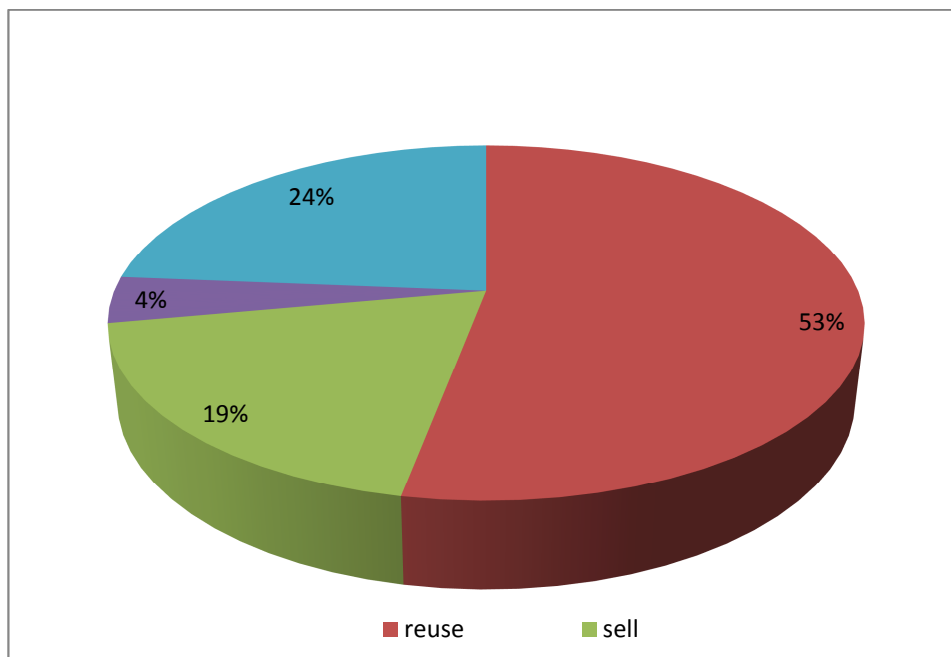


**Source:** Field Survey, June 2010

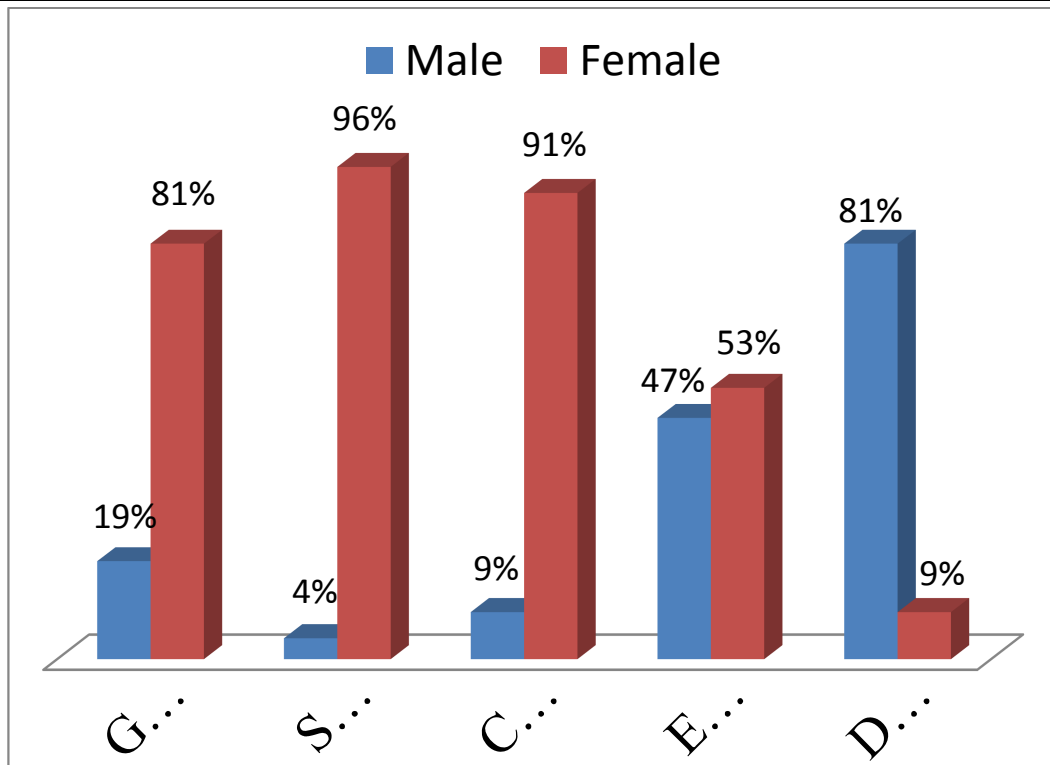
Fig 2 Relationship between Education, Income and Waste Generation



**Figure 3 Number Of Solid Waste Storage Containers in the House**



**Figure 4 Reasons for segregation at household level**



**Source:** Field Survey, June 2010

Figure 5 Distribution of Responsibilities Based On Gender

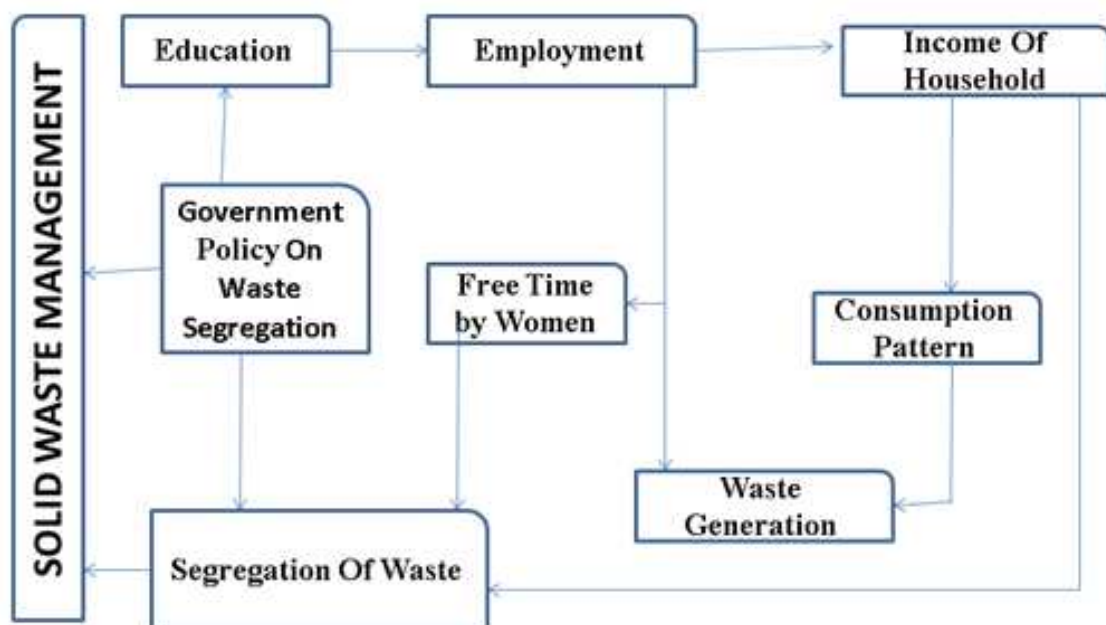


Figure 6 Analysis Of Factors Determining Solid Waste Segregation

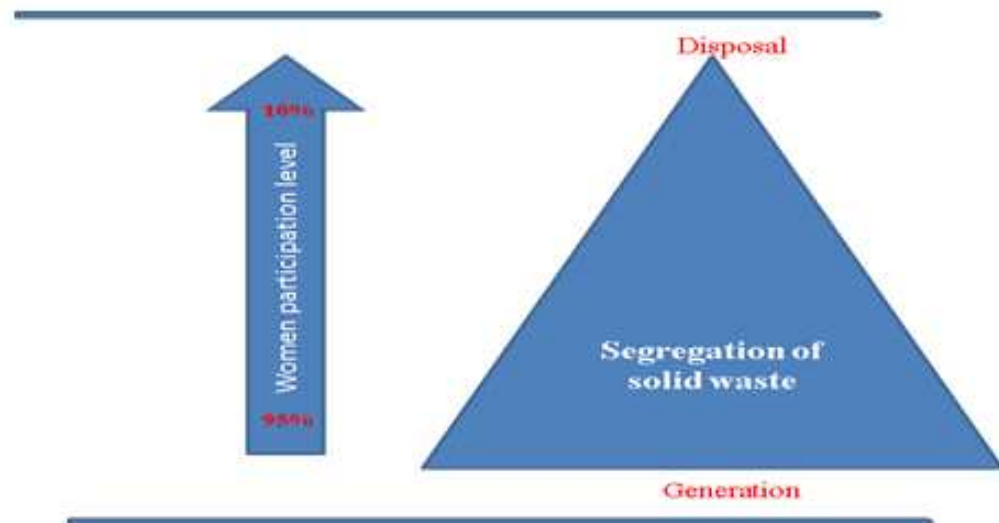


Figure 7 SegregationPyramid

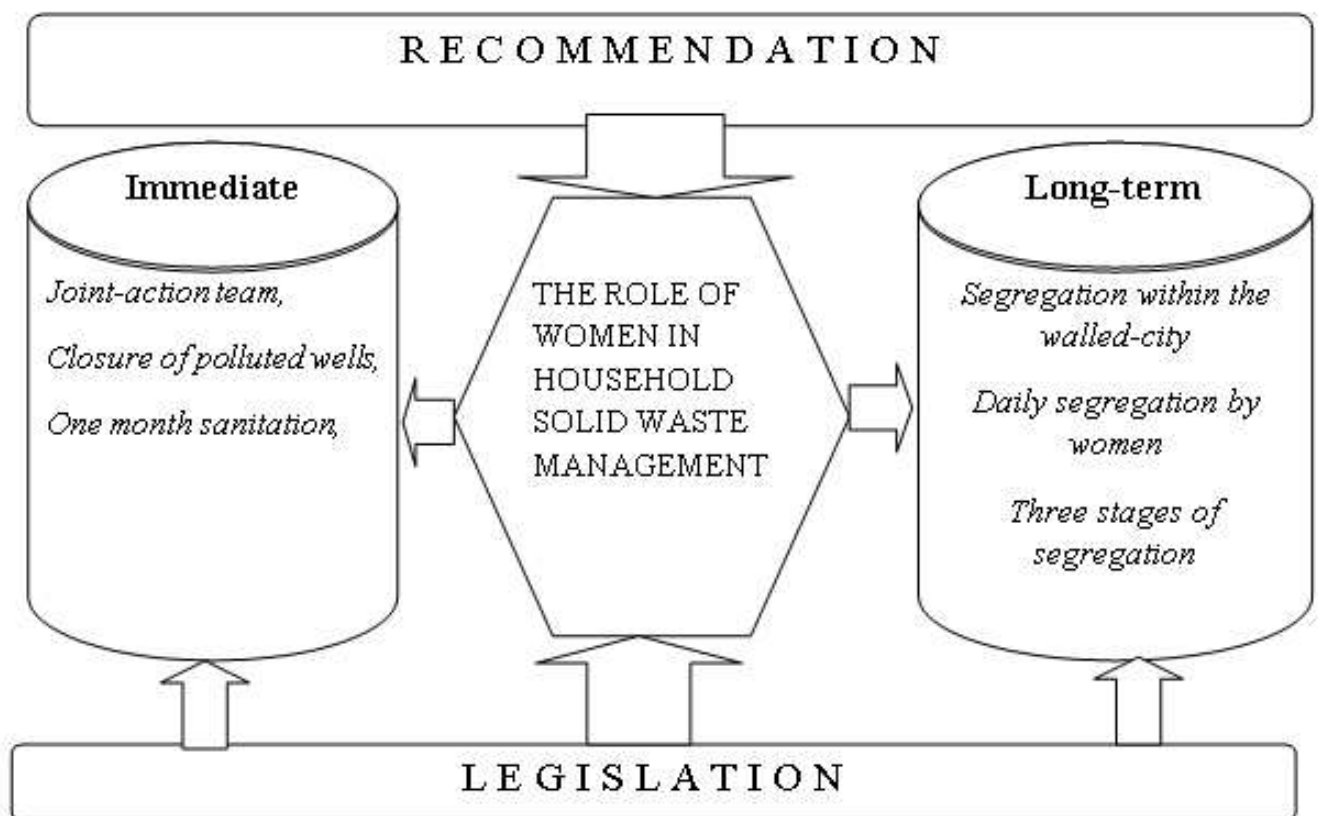


Figure 8 Summary of Recommendation



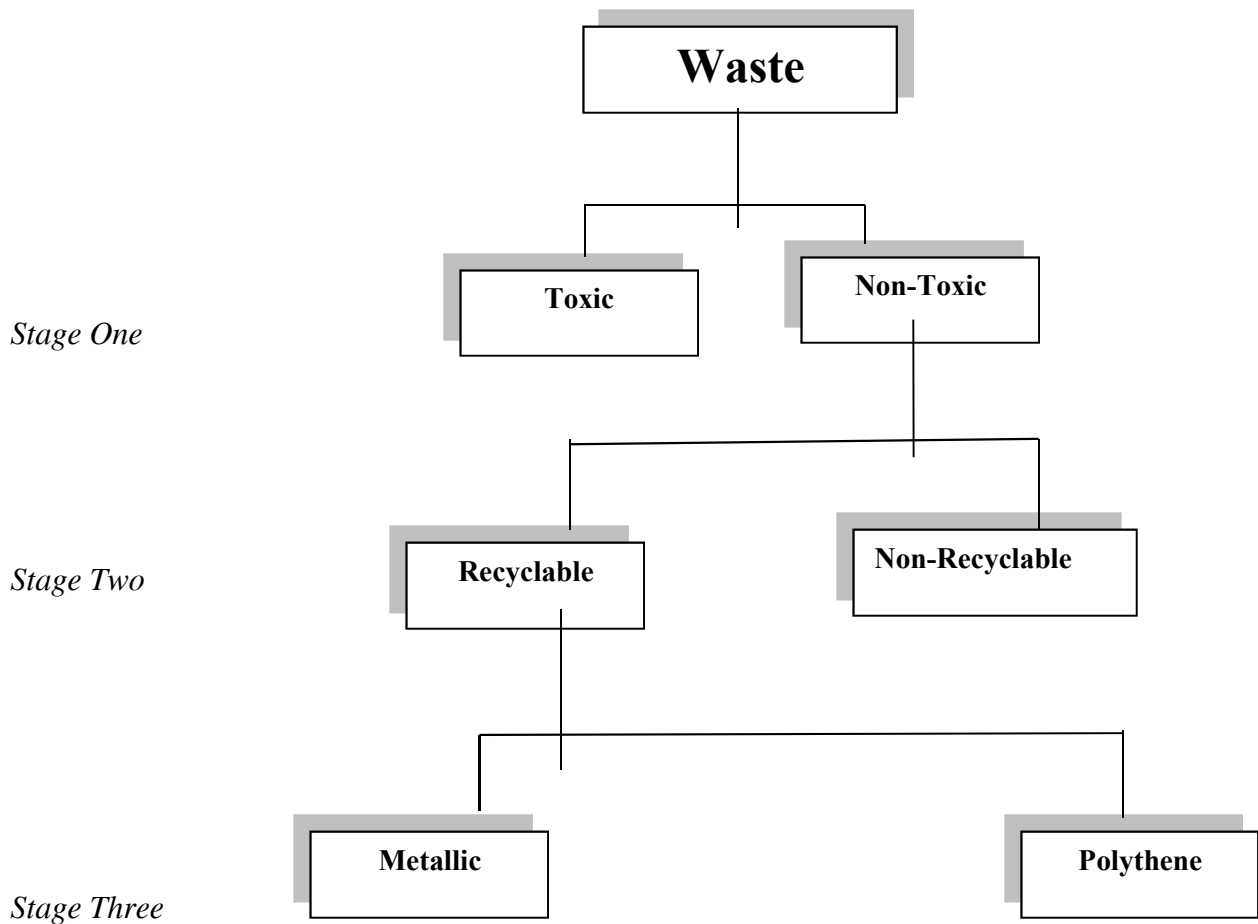


Figure 9 Stages Of Solid Waste Segregation At The Household Level

This academic article was published by The International Institute for Science, Technology and Education (IISTE). The IISTE is a pioneer in the Open Access Publishing service based in the U.S. and Europe. The aim of the institute is Accelerating Global Knowledge Sharing.

More information about the publisher can be found in the IISTE's homepage:

<http://www.iiste.org>

The IISTE is currently hosting more than 30 peer-reviewed academic journals and collaborating with academic institutions around the world. **Prospective authors of IISTE journals can find the submission instruction on the following page:**

<http://www.iiste.org/Journals/>

The IISTE editorial team promises to review and publish all the qualified submissions in a fast manner. All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Printed version of the journals is also available upon request of readers and authors.

### **IISTE Knowledge Sharing Partners**

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digital Library, NewJour, Google Scholar

